

CLAIMS

1. Apparatus for monitoring fetal behaviour comprising:
an input for receiving ECG data from a set of electrodes attached to a
5 maternal body;
a waveform pre-processor for identifying a succession of fetal ECG
complex waveforms within the received data;
a waveform processor for determining differences in the succession of fetal
ECG complex waveforms over time; and
10 an event logger determining from the determined differences a number of
fetal movements during the period of time.
2. The apparatus of claim 1 further including a plurality of electrodes for
positioning at different locations on the maternal abdomen.
- 15 3. The apparatus of claim 2 in which the number of electrodes is two.
4. The apparatus of claim 1 in which the waveform pre-processor includes a
discriminator for discriminating between maternal ECG complexes and fetal ECG
20 complexes in a received waveform.
5. The apparatus of claim 4 in which waveform pre-processor includes means
for subtracting the maternal ECG complexes from the received waveform.
- 25 6. The apparatus of claim 1 in which the waveform pre-processor comprises
means for identifying the QRS complex in the fetal ECG data.
7. The apparatus of claim 1 in which the waveform processor comprises:
a memory storing a plurality of fetal ECG complex templates each
30 corresponding to a specific fetal spatial presentation and/or position;
a comparator for comparing each of the identified fetal ECG waveforms
with a set of predetermined ones of the fetal ECG complex templates and

determining at least one template from said set of templates that best matches each identified fetal ECG waveform.

8. The apparatus of claim 7 in which the memory stores a plurality of fetal ECG complex templates each corresponding to a specific fetal spatial presentation and/or position relative to a specific electrode configuration.

9. The apparatus of claim 7 in which the event logger records occasions on which the determined template changes.

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10. The apparatus of claim 7 further includes means for selecting the set of predetermined fetal ECG templates according to a configuration of ECG electrodes positioned on the maternal abdomen.

11. The apparatus of claim 7 in which the set of predetermined fetal ECG templates includes templates corresponding to at least cephalic presentation, breech presentation, shoulder dorsoanterior presentation and shoulder dorsoposterior presentation.

12. The apparatus of claim 1 in which the waveform processor comprises means for detecting phase changes between successive fetal ECG complex waveforms.

13. The apparatus of claim 12 in which the waveform processor comprises means for detecting phase changes of one or more predetermined magnitudes between successive fetal ECG complex waveforms.

14. The apparatus of claim 12 or claim 13 in which the event logger records occasions on which a phase change occurs.

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15. The apparatus of claim 1 in which the waveform processor is adapted to determine differences in fetal complex waveforms by detecting change in the

positive and/or negative energy of a fetal ECG complex waveform relative to a reference.

16. The apparatus of claim 15 in which the waveform processor is adapted to
5 determine differences in fetal complex waveforms by detecting changes in the relative quantities of positive and negative energy of a fetal ECG complex waveform relative to a baseline.

17. The apparatus of claim 15 in which the reference comprises a previous or
10 average fetal ECG complex waveform.

18. The apparatus of claim 1 further including a display for displaying a count of the number of fetal movements detected.

19. The apparatus of claim 1 wherein the waveform processor further includes
15 a fetal heart rate monitor.

20. The apparatus of claim 1 further including an alarm for indicating if the number of fetal movements during a period of time falls below a predetermined
20 threshold.

21. The apparatus of claim 1 further including a memory for storing fetal movement event data and an electronic interface for downloading said event data to
25 a remote device.

22. A method for monitoring fetal behaviour comprising:
(i) obtaining fetal ECG data over a period of time;
(ii) identifying a succession of fetal ECG complex waveforms within the data;
(iii) determining differences in the succession of fetal ECG complex waveforms
30 over time; and
(iv) determining from the determined differences a number of fetal movements during the period of time.

23. The method of claim 22 in which step (i) comprises obtaining fetal ECG data from a plurality of electrodes positioned at different locations on the maternal abdomen.

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24. The method of claim 23 in which step (ii) includes the step of discriminating between maternal ECG complexes and fetal ECG complexes in a received waveform.

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25. The method of claim 24 in which step (ii) includes subtracting the maternal ECG complexes from the received waveform.

26. The method of claim 22 in which step (ii) comprises identifying the QRS complex in the fetal ECG data.

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27. The method of claim 22 in which step (iii) includes:
comparing each of the identified fetal ECG waveforms with a set of predetermined fetal ECG complex templates; and
determining at least one template from said set of templates that best
20 matches each identified fetal ECG waveform.

28. The method of claim 27 in which step (iv) comprises determining the number of successive occasions on which the determined template changes during the period of time.

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29. The method of claim 27 in which the set of predetermined fetal ECG templates is selected according to a configuration of ECG electrodes positioned on the maternal abdomen.

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30. The method of claim 27 in which the set of predetermined fetal ECG templates includes templates corresponding to at least cephalic presentation, breech

presentation, shoulder dorsoanterior presentation and shoulder dorsoposterior presentation.

31. The method of claim 27 in which step (iii) comprises detecting phase
5 changes between successive fetal ECG complex waveforms.

32. The method of claim 22 in which step (iii) comprises detecting phase
changes of one or more predetermined magnitudes between successive fetal ECG
complex waveforms.

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33. The method of claim 31 or claim 32 in which step (iv) comprises
determining the number of successive occasions on which a phase change occurs
during the period of time.

15 34. The method of claim 22 in which the differences determined in step (iii)
comprises change in the positive and/or negative energy of a fetal ECG complex
waveform relative to a reference.

20 35. The method of claim 34 in which the differences determined in step (iii)
comprise changes in the relative quantities of positive and negative energy of a
fetal ECG complex waveform relative to a baseline.

36. The method of claim 34 in which the reference comprises a previous or
average fetal ECG complex waveform.

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37. The method of claim 22 further including the step of displaying or logging a
cumulative count of the number of fetal movements within the period of time.

38. The method of claim 22 further including the step of monitoring fetal heart
30 rate.

39. The method of claim 22 further including the step of indicating an alarm condition if the number of fetal movements during the period of time falls below a predetermined threshold.

5 40. Apparatus for determining fetal spatial presentation and/or position within the uterus comprising:

an input for receiving ECG data from a set of electrodes attached to a maternal abdomen in a predetermined configuration;

10 a waveform pre-processor for identifying a number of fetal ECG complex waveforms within the data;

a memory storing a plurality of fetal ECG complex templates each corresponding to a specific fetal spatial presentation and/or position;

15 a comparator for comparing each of the received waveforms with a set of the plurality of fetal ECG complex templates ascribed to the predetermined electrode configuration and determining a template from said set of templates that best matches the identified fetal ECG waveforms.

41. The apparatus of claim 40 in which the waveform pre-processor comprises means for discriminating between maternal ECG complexes and fetal ECG
20 complexes in the received ECG data.

42. The apparatus of claim 41 in which the waveform pre-processor includes means for subtracting the maternal ECG complexes from the received ECG data.

25 43. The apparatus of claim 40 in which the waveform pre-processor comprises means for identifying the QRS complex in the fetal ECG data.

44. The apparatus of claim 40 further including means for selecting the set of predetermined fetal ECG templates to be used according to the configuration of
30 ECG electrodes positioned on the maternal abdomen.

45. The apparatus further including a set of said electrodes for attachment to the maternal abdomen.

46. The apparatus of claim 45 in which the number of electrodes is two.

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47. The apparatus of claim 40 in which each template corresponds to a specific fetal spatial presentation and position relative to a specific electrode configuration.

48. A method for determining fetal spatial presentation and/or position within the uterus comprising:

- 10 (i) obtaining fetal ECG data from a plurality of electrodes positioned on the maternal abdomen in a predetermined configuration;
- (ii) identifying a number of fetal ECG complex waveforms within the data;
- (iii) comparing each of the waveforms with a set of predetermined fetal ECG complex templates ascribed to the predetermined electrode configuration; and
- 15 (iv) determining a template from said set of templates that best matches the identified fetal ECG waveforms.

49. The method of claim 48 in which step (ii) includes the step of discriminating between maternal ECG complexes and fetal ECG complexes in a received waveform.

50. The method of claim 49 in which step (ii) includes subtracting the maternal ECG complexes from the received waveform.

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51. The method of claim 48 in which step (ii) comprises identifying the QRS complex in the fetal ECG data.

52. The method of claim 48 in which the set of predetermined fetal ECG templates is selected according to the configuration of ECG electrodes positioned on the maternal abdomen.

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53. The method of claim 48 or claim 52 in which the number of electrodes is two.

54. The method of claim 48 in which each template corresponds to a specific
5 fetal spatial presentation and position relative to a specific electrode configuration.